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Artificial intelligence and Routine Blood Investigations

Bajpai Sourabh[1], Khan Saher[2], Afaq Nashra[3], Aimon Abbas[4], Jafri Tanveer Raza[5], Andriyas Ekta[6*]

[1] PG Student, Department of MLT, Sai Institute of Paramedical &Allied Health Sciences Centre, Dehradun, Uttrakhand, India.

[2]Lecture, Department of MLT, Era University, Lucknow, Uttar Pradesh, India.

[3] Research Associate, Department of Microbiology and Central Research Laboratory, Rama Medical College Hospital and Research Centre, Uttar Pradesh, India.

[4]Tutor, Department of Allied Science and Research, Era University, Lucknow, Uttar Pradesh, India.

[5] Lecture, Department of MLT, Era University, Lucknow, Uttar Pradesh, India.

[6]Assistant Professor, Department of MLT, Era University, Lucknow, Uttar Pradesh, India.

Abstract: Artificial intelligence has impacted every field of our lives and also includes an impact on the medical industry (AI). The application of artificial intelligence (AI) to routine blood examinations has proven beneficial to society and has the potential to improve diagnosis accuracy, efficiency, and patient care. The cornerstone of the medical field, blood testing is an essential diagnostic tool that offers critical information concerning a patient's health. However, the capacity to comprehend these tests that depend only on human expertise carries limitations that may give rise to variability. The dynamic of blood testing is being drastically changed by the way AI is being included in tests. These days, artificial intelligence algorithms—particularly those that utilize deep learning and machine learning—can analyze huge amounts of data incredibly quickly and accurately. This study has been taken to find the impact of Al in a few decades from 2040 on data availability, Clinical impact, regulatory framework, etc. It is projected that routine blood testing will employ AI technology more often as it grows, providing progressively greater capabilities and significantly transforming the process of healthcare.

Keywords: AI-driven diagnostic technologies, Healthcare sector, Integration with Electronic Health Records (EHR), Personalized Medicine, Predictive Analytics

Corresponding Author:
Andriyas Ekta
Assistant Professor,
Department of MLT,
Era University, Lucknow,
Uttar Pradesh, India.
Email ID: ekta2529@gmail.com

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INTRODUCTION

Routine blood tests not only help to monitor the progress of medication but also provide the body status & help to diagnose pathology in the early stage. These routine test parameters not only include Complete Blood Count, but the organ function tests like Liver & kidney profile tests, the other important parameters are the Diabetic panel test, Electrolyte, Coagulation factor & study of Enzyme activity i.e. Trop T & Trop I. It was a haptic task for the patient & healthcare services to provide all services on time with minimum error but as we moved toward integration of AI it's not only reduced time but also the error which occurred earlier.

Artificial intelligence has revolutionized every field. The medical field has also been left apart by the influence of artificial intelligence (AI). The Use of AI in routine blood investigations has also benefited society and holds the potential to significantly impact the accuracy efficiency, and patient care in diagnosis. Blood testing is the backbone of the medical field and is a vital diagnostic instrument in medicine, offering vital information about a patient's state of health. But is been limited for its worth on human expertise to interpret these tests and thus can have limitations and variability.

How AI is revolutionizing blood tests and completely transforming the landscape of blood testing by Reuters Today, AI algorithms (particularly machine learning and deep learning approaches) can analyze massive datasets at blinding speeds with high precision. Such technologies can catch patterns and anomalies in the data from blood tests that even trained professionals would miss, and this leads to a diagnosis earlier than traditional methods which will increase the accuracy of the results (Topol, 2019). AI is additionally enhancing clinical decision-making through AI-driven diagnostic technologies that empower healthcare professionals to make more knowledgeable, data-dependent decisions (Shah et al., 2019).

Artificial intelligence is not only improving the quality of diagnosis but also introducing personalized treatment possibilities. AI can analyze complex data sets to allow clinicians the ability to tailor therapies and monitoring techniques for each patient to improve treatment outcomes (Esteva et al., 2021). As the AI matures its use in routine blood testing is expected to grow and so deliver even greater power, changing forever how healthcare is delivered.

BACKGROUND

The Healthcare industry is probably the most seriously affected by AI and especially within diagnostics, Artificial Intelligence (AI) has made a huge revolution. As one of the most routine clinical practices, traditional blood testing is manually analyzed and interpreted subjectively by humans. Although it is successful, this technique has limitations that are primarily human errors, variability, and manual data processing (Lehman et al., 2019). The application of AI in this industry addresses these problems, as it automates and enhances analytical capabilities.

Artificial intelligence (AI) technologies, particularly those based on deep learning and machine learning have shown tremendous potential in untangling convoluted blood analysis data. Conversely, these technologies are phenomenal in pattern recognition allowing for the detection of even the subtlest of abnormalities that a doctor may otherwise miss (Esteva et al. 2021). Moreover, AI systems can handle much more complete and accurate information than general practitioners who are dealing with large numbers of patients every day and hence they may miss crucial bits of information that could come in handy for a faster and possibly more precise diagnosis (Topol, 2019).

The use of AI in blood tests is similarly advancing the front in personalized treatments. AI would be able to help customize diagnostic and therapy strategies based on tables of unique patient data, providing a more personalized healthcare intervention (Shah et al., 2019) When it comes to chronic illness, which care is most effective when a team of caregivers can monitor an individual and adjust treatment ideally leading to self-management and maintenance of health more data avenues are needed for knowledge discovery.

AI IN DIAGNOSTIC

With the evolution of AI and improved abilities, it is expected that this trend of increased AI involvement in routine blood testing will expand, offering new opportunities to develop patient care results as well as helping to make diagnoses faster and more accurate. However, using AI also raises several key concerns that should be addressed. Among these are the need for robust AI-tool validation procedures, integrating AI systems into existing clinical workflows, and conducting ongoing training among healthcare providers to use these technologies effectively (Lehman et al. 2019).

Recent advancements in artificial intelligence (AI) revolutionized the field of routine blood testing, transforming diagnostics from simple algorithmic applications to complex unified systems. AI has gone from research to clinical tools, at least important ones as in the last decade (Esteva et al. According to Rajkomar et al. However as much has been noted by Esteva et al. Using large sets of diagnostic data and emerging technologies, AI is poised to help revolutionize blood testing even further in the years ahead, eventually leading to even greater improvement in healthcare outcomes (Bibbins-DominThis change in blood testing went through a paradigm shift from just simple algorithmic applications to much more sophisticated and integrated systems due to AI revolution. AI Updated at least the essential AIs have moved from research to clinician tools in a 10-year timespan. According to Rajkomar et al. 2019, and Esteva et al. 2021 also observed This combination of a clinically validated set that is both large enough and designed with emerging technologies to enable AI is indicative of the progress in how AI will help revolutionize blood testing further still in the next few years with even greater healthcare impact (Bibbins-Domingo et al., 2020).

In a decade, AI for an everyday blood test has evolved from relatively simple machine-learning models with limited clinical utility to more complex systems that are capable of high-level data fusion and diagnostic accuracy (Esteva et al., 2019). Over the past decade, these technologies have reached deep learning performance and possess substantial data integration capability; both together can greatly improve operability and therapeutic outcomes (Rajkomar et al. 2019). They predict that technologies like quantum computing and real-time data analytics have the potential to make AI even more commonplace, from the everyday blood test alone to levels of precision and personalized medicine that we can all scarcely imagine (Bibbins-Domingo et al., 2020). It only demonstrates a period in which AI is being calculated to improve our current blood test process and how powerful it is now in our healthcare ecosystem.

The combination of artificial neural networks (ANN) with classical CBC parameters has shown promising results in the management of blood disorders, especially for the diagnosis and differentiation between Iron Deficiency Anemia and Thalassemia. An investigation of Yilmaz et al., 2012demonstrated high accuracy (≥0.98) with no requirement of feature selection, which suggests good practical deployment in clinical settings. Barnhart-Magen et al.,(2013) showed a good specificity in the case of thalassemia minor, but it fell concerning the differentiation diagnosis with iron deficiency anemia. Çil et al. (2020), managed to boost differentiations using gender-specific algorithms. Although studies regarding the pathophysiology of diabetes have mostly focused on endocrine and metabolic anomalies. While Kushner et al. Shallow Neural Networks for Improved Blood Glucose Prediction in Type 1 Diabetes Kopitar et al.,(2020). The linear regression models were found to be unaltered and better for detecting type 2 diabetes according to (2020) Bernardini et al. 2019 showed no changes in blood parameters other than glycemia. We used the baseline data from this study reported elsewhere (2019) to represent early insulin resistance and multiple machine-learning models were applied to detect separate predictors for polyneuropathy and iatrogenic hypoglycemia.

Table 1: How AI can be used in the past present and future various aspects in talk about

Aspect	Last Decade (2010-2020)	Present Decade (2020-2030)	Next Decade (2030-2040)
Technology	Basic ML algorithms, limited clinical use	Advanced deep learning, broader clinical use	Emerging tech (quantum AI), routine use
Data Availability	Smaller datasets, minimal integration	Large datasets, improved integration	Extensive real-time data, seamless integration
Clinical Impact	Initial trials, limited application	Enhanced accuracy, broader adoption	Routine use has, a significant impact
Regulatory Frameworks	Developing guidelines	Established guidelines	Mature, comprehensive frameworks
Ethics	Emerging concerns	Focus on transparency, bias reduction	Emphasis on equity and access

AI PAST, PRESENT & FUTURE

The increasing use of artificial intelligence (AI) in common blood tests is transforming the diagnostics area, bolstering precision, productivity, and predictive abilities as evidenced in multiple scientific research:

Automated Analysis Blood test results and interpretations are becoming increasingly mechanized with approaches like the ones that regularly employ automatic machine-learning algorithms. These systems are highly accurate in identifying patterns and anomalies while processing large data quickly. A Nature Medicine study found that in blood sample cancer detection, for instance, AI models could outperform human pathologists (Esteva et al., 2019).

Blood Test-Related Forecasts By observing patterns in blood test results, predictive analytics is used to give early warnings of potential health issues by AI technologies. Studies published in The Lancet Digital Health have had a high tendency to claim accurate predictions of common disorders, such as diabetes and cardiovascular disease, with low to moderate quality through the use of AI on historical data or biomarkers (Rajkomar et al. This predictive ability makes early intervention and preventative care a reality.

AI assists with personalized medicine to accommodate treatment regimens based on a patient's specific blood indicators. Research, such as that published in JAMA Network Open has examined this approach and how AI could analyze patient-specific data that tailor disease treatment plans (Bibbins-Domingo et al., 2020).

Tab 2: shows the comparison of enhanced use of AI in the cogitative Decade.

Aspect	Last Decade (2010-2020)	Presentt Decade (2020-2030)	Next Decade (2030-2040
Technology	20%	50%	80%
Data Availability	25%	60%	90%
Clinical Impact	15%	50%	80%
Regulatory Frameworks	10%	40%	75%
Ethics	15%	45%	70%

Utilizing Artificial Intelligence with EHR: Also, AI integrated with EHR enhances real-time access and interpretation of blood test data. As outlined in a recent article published in Health Affairs, the research into the potential benefits and costs of AI provides quantitate models of how these new technologies can make more efficient both data integration and decision processes, therefore, can lead to a reduction in time spent on administrative data (Adler-Milstein et al 2021).

Quality Control: Minimizing human errors & ensuring compliance with test protocols that come with the help of AI, encourages better quality in blood tests. Studies have shown that AI could help to standardize and improve the accuracy of diagnostic workups, especially in clinical chemistry (Wang et al., 2020). Nevertheless, conversations regarding the role of AI in traditional blood tests also raise concerns about algorithmic bias, data privacy, and the need for rigorous validation and oversight to ensure fair and accountable healthcare.

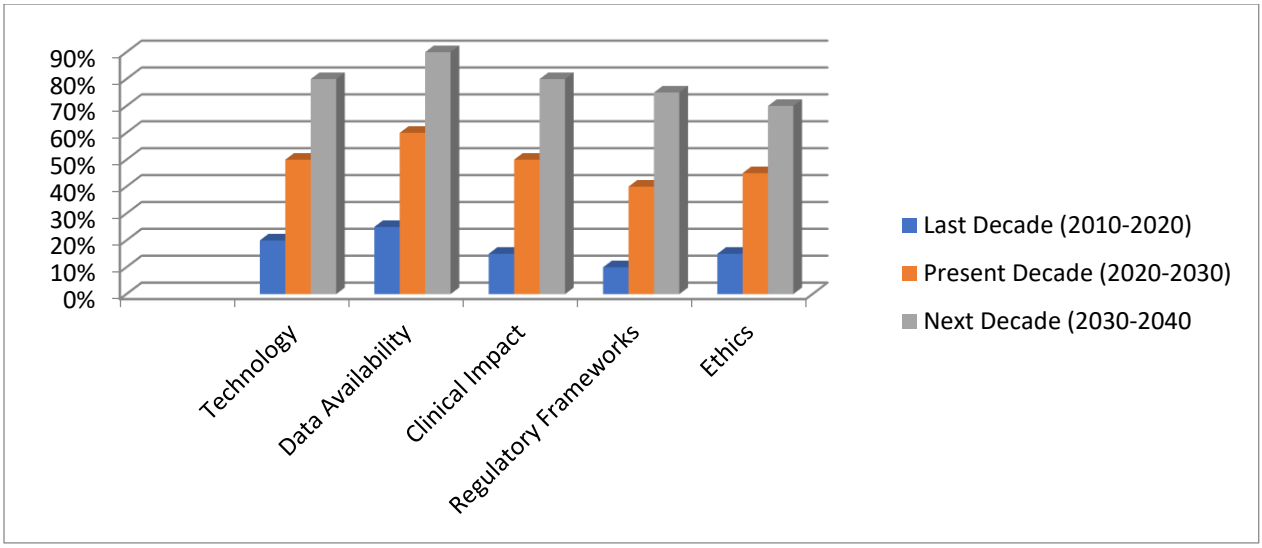

Fig 1.1 shows's comparison of the use of AI in the past, present, and future.

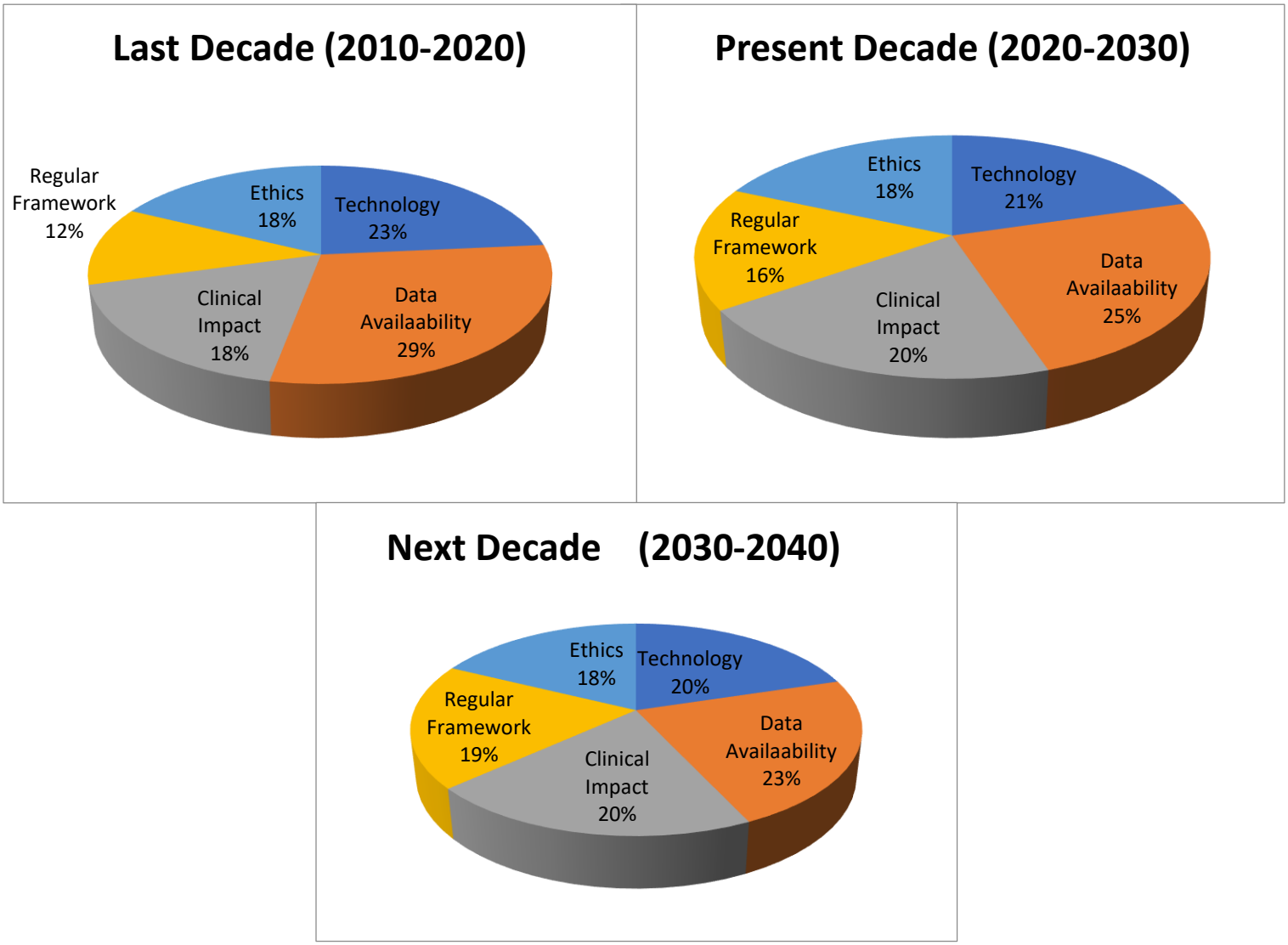

Fig 1.2 show's comparison of the enhancement in the use of AI in past, present, and future decades for the various aspects.

Challenge.

Despite all the advancements made by artificial intelligence, specifically in big data, computational power, and neural networks; it remains difficult to apply AI solutions at the clinical level. Studies suggest that adding AI to standard blood analysis and other diagnostic tasks in healthcare settings is very slow. The requirements for third-party apps, the opaqueness of AI models, and concerns about infringing on physician autonomy are some of the challenges (Henry et al., 2022) this citation messing in referencing list. Moreover, the accuracy of AI models is entwined with changes in their data sources (e.g., weather and sensor noise) and settings (Stegmann et al., 2020). Evaluations of usual care conditions are required to understand how best to integrate innovations into healthcare workflows accurately because research often relies

on retrospective data rather than clinical settings in the real world Co-operation.

CONCLUSION

AI might help practitioners catch even very small anomalies that human reviewers could overlook and AI systems are more accurate at analyzing blood test data than the traditional methods. For example, changes in blood cell counts/measurable biomarkers can be examined by AI systems to spot illnesses like cancer or anemia at the earliest instances. Therefore the analyzing process of big blood test data can be automated, which might speed up the time to findings. Thus, timely decisions resulting in early implementation of treatment plans may take place. Health outcomes can be returned to your patients in terms of test results, using historical data and smart algorithms. As another example, it can predict the likelihood of long-term conditions or who should have additional checks or preventative health advice. Because AI can combine the blood test data with EHRs, a more complete view of a patient's health is possible and it allows for better informed clinical decisions and individualized treatment plans. Where it can identify abnormality or discrepancy in test findings, especially in laboratory-based settings, it enables better quality control procedures providing more human error-free and reliable tests overall.

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